

Observations of Low-Latitude Ionosphere Variability

Elsayed R. Talaat
JHU/APL

The ionosphere is highly variable and has a complex system of drivers including variable solar radiation, geomagnetic activity, and forcing from the lower atmosphere. While magnetospheric forcing dominates the variability at high latitudes in the ionosphere and thermosphere, photochemistry and neutral dynamics play dominant roles in ionospheric structure and variability at mid and low latitudes. Long-term ionosphere measurements have recently become available from several satellite missions. The TOPEX and JASON satellites obtain the total electron content (TEC) from ~1200 km orbit and the DMSP satellites measure the in-situ ion densities at ~800 km, while the GUVI instrument onboard the TIMED satellite retrieves the electron density profile below ~550 km altitude. This rich dataset allows us to examine the solar activity effects on the low-latitude ionosphere on different timescales - including solar flare, rotational, and 11-year solar cycle effects. In addition, the wind-driven E-region dynamo generates large-scale electric fields, causing upward plasma drifts that combine with pressure forces and gravity to form the equatorial ionization anomaly in electron density. As a result, variability in E-region winds could translate upwards into the low-latitude ionosphere. The dominant dynamical feature in the E-region is the diurnal tide, and its seasonal, interannual, and daily variability are important factors in understanding the behavior of the ionosphere. Momentum deposition by the diurnal tide at low latitudes in the lower thermosphere produces indirect circulations that will transport neutral and ionized constituents both vertically and horizontally to higher latitudes. In this talk we describe the effects of solar activity on the low-latitude ionosphere as observed by various measurements, including the maximum electron number density, the peak height, the latitudinal separation of the equatorial arcs, the asymmetry of the peak densities. We also examine the relationship between the variability observed in mesospheric and lower thermospheric dynamical fields to variations observed in the low latitude ionosphere using these long-term global satellite observations.